A COST PER BEHAVIOR CHANGE ANALYSIS FOR PHYSICAL THERAPY-BEHAVIOR MODIFICATION PROJECTS

An abstract of a Thesis by
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The problem. To develop a method which could be used to determine the effects and related costs of producing certain physical-motor skills in multiply handicapped retardates. This study should provide a data base for later cost-effectiveness studies.

Procedure. Child development workers on the program unit were trained to conduct physical therapy-behavior modification projects. The effectiveness of these projects was evaluated by comparing performance prior to intervention with performance following intervention. Costs for achieving this change in performance were presented in five separate categories. The first was the number of hours of treatment necessary to produce the behavior change multiplied by the hourly wage of the CDW who conducted the treatment, the second was the cost for medical intervention, the third was the cost for reinforcers and the fourth represented the costs of consultation by the physical therapist and the behavior modifier. The final category was simply the total cost of treatment.

Findings. It was possible to isolate the cost variables necessary for producing behavior change. Cost per behavior change was determined for twenty-six specific behaviors.

Conclusion. Direct treatment by non-professional CDWs was shown to be an effective means of producing behavior change and treatment by these non-professionals was found to be economically feasible.

Recommendations. The data from this study and similar studies should be used to develop a model which can be used to evaluate the cost-effectiveness of such programs.

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CHAPTER I

INTRODUCTION

The planning-programming-budgeting system (PPBS) is a budgetary procedure which has been used by the Department of Defense to integrate military budgeting with military planning. The purpose of PPBS has been to present decision makers with a systematic and comprehensive method of comparing the costs and benefits of alternative approaches to meeting an objective. Because of its apparent success in the Department of Defense, an executive order was issued in 1965 directing the department heads of all other federal agencies to institute similar budgetary procedures (Alexander & Messal, 1972).

Gettings (1968) has enumerated several distinctions between PPBS and traditional budgeting methods. PPBS has emphasized: (1) the end product or the output of the investment of funds, (2) the development of quantifiable measures of program output, (3) the consideration of long range costs of alternative programs, and (4) the use of cost-effectiveness analysis. That is, the use of analytical and evaluative tools to study program objectives and alternative ways of achieving them. Thus PPBS has required the careful specification and analysis of program objectives, approaches, outputs and costs.

The actual integration of PPBS into some federal agencies, particularly the Department of Health Education and Welfare has progressed slowly. The major reason for this delay has been that the objectives of education and mental health programs have always been expressed in general terms which were neither quantifiable nor measurable.

Carpenter and Haggart (1970) have discussed the problems of defining and measuring the effectiveness of educational programs. They concluded that valid and reliable methods of assessing the effectiveness of current educational programs must be developed before it is possible to use cost-effectiveness to analyze alternative programs.

Wilkinson (1972) has classified costing techniques into three types: descriptive, predictive and comparative. These three costing techniques form a hierarchy of increasing complexity where the descriptive cost studies are the essential data base upon which all other costing studies will be built. According to Wilkinson the basic requirement for the descriptive cost study is an accurate means of measuring out-put quality and/or quantity. He has also concluded that a precise description and evaluation of output is a necessary component before cost-effectiveness analysis is possible.

The differences between PPBS systems and the traditional mental health systems have loomed even larger than those which existed between education and PPBS. Many

specialists in the field of mental health have expressed a concern that, with PPBS, program decisions will be based on economic considerations alone (Alexander & Messal, 1972; Gettings, 1968). Alexander and Messal have reported a number of critical differences between the mental health specialist and the PPBS specialist. First, PPBS specialists have assumed that each program has a purpose and a set of objectives arrived at with the common agreement of those concerned. Mental health specialists have been unable to present a common purpose and set of objectives because the field of mental health has accepted a wide diversity of treatment orientations.

Second, PPBS specialists have assumed that objectives can be stated in quantifiable, measurable terms. In the past objectives in the field of mental health have not been identified or specified clearly enough to permit measurement or quantification.

Finally, PPBS specialists have assumed the criteria of effectiveness will be oriented to outcome or productivity. However, this has not been possible in mental health until recently, since treatment objectives have not previously been specified in measurable terms.

To date, much of the cost research in mental health has been concerned with the comparison of costs for treatment facilities and health services rather than the costs for

treatment effectiveness. Don and Amir (1969) have presented a comparison of government institutions for the mentally retarded with public and private facilities for this population. A similar comparison has been drawn between costs of hospital and community care for chronic mental patients (Cassell, Smith, Grunberg, Boan, & Thomas, 1972). Both of these analyses were based primarily on budgetary considerations between physical plants, and neither program was evaluated in terms of treatment effectiveness.

Goodwin and Rosenblum (1972) have presented a method for measuring the costs of treatment offered by two mental health clinics. They have devised a method to measure the quantity of service produced and the amount of money expended for this treatment. They have failed, however, to provide a quantifiable means of assessing program effectiveness.

The value of the program planning paradigm has been discussed by Noar and Balthazar (1973) as a systematic method for planning, developing and evaluating a program for mentally retarded children. Although they presented a standardized measure of behavior change which permitted an evaluation of program effectiveness, they have not attempted to discuss the cost of their program as it related to behavior change.

This study assessed the cost of a behavior modification-physical therapy treatment program for profoundly retarded and multiply handicapped children. The effectiveness of this

program was evaluated through the use of behavior change data, and the cost of the program was directly related to the effectiveness of the program.[1]

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CHAPTER II

METHODS

Subjects

The subjects for this study were 46 residents of Woodward State Hospital-School who were placed in a federally funded program from June 1, 1971, to December 31, 1972. The subjects were multiply handicapped with neurological, muscular, glandular, orthopedic, and numerous other difficulties as well as mental retardation. Because the project ward accepted all handicapped residents who might benefit from the treatment provided there was considerable variation in the physical and mental capabilities represented. However, more than 90% of the subjects were categorized as profoundly retarded, total care patients because of their multiple physical and mental deficiencies.

Program Procedure

The Hospital Improvement Program (HIP) was located on two wards at the Woodward State Hospital-School. The establishment of the unit represented an attempt to integrate physical therapy and behavior modification methods and to train a staff of nineteen non-professional workers to function as physical therapy aides skilled in behavior modification.

At any one time the project provided physical

habilitation services to 30 severely handicapped residents living on the unit. These residents were given intensive treatment in a physical therapy program which used behavior modification techniques to eliminate deficits in the residents' physical skills. The combination of physical therapy and behavior modification worked well for two reasons. Both treatment methods require that treatment procedures be designed specifically for the individual, and both techniques require an observable change in performance as a measure of effectiveness.

The staff on the HIP unit were all child development workers (CDW) who were currently employed at the hospital and had elected to work on the unit. Each of the nineteen CDWs received a sixteen-hour course in behavior modification and a ten-hour course in physical therapy techniques. The course work consisted of lectures, discussions, demonstrations and supervised practical experience in behavior modification and physical therapy. The physical therapy course was taught by a registered physical therapist who was employed full-time on the unit. The behavior modification course was taught by the behavior modification consultant, a graduate student who worked fifteen hours a week on the unit. The treatment efforts of the CDWs were supervised regularly by the physical therapist and the behavior modification consultant.

Each resident selected for the project received an initial developmental evaluation, a range of motion evaluation, and a reflex evaluation from the physical therapist. Based on the information received from this evaluation the physical therapist chose the appropriate skill to teach each child.

The formal physical therapy-behavior modification projects were designed to teach behaviors such as maintaining sitting balance, acquiring standing position, independent ambulation, etc. A complete list of behaviors on which projects were run is shown in Table 1. After an appropriate target behavior was identified the physical therapist and the behavior modification consultant designed a procedure to measure the baseline, or pretreatment, level of this specific behavior.

The baseline procedure was explained to the CDW who was responsible for the child being evaluated. The behavior modification consultant observed the first day of baseline to insure that the CDW understood the criteria for counting the responses and that the behavior was being measured correctly. The CDW measured and charted the resident's daily performance. The recorded measure of the baseline was examined by the behavior modification consultant and the physical therapist. If the baseline measure was extremely variable the measurement technique of the CDW was again

observed directly to make certain that the proper procedures were being used.

Once a stable pattern developed in the baseline, the physical therapist and behavior modification consultant analyzed the resident's entire baseline performance in order to determine the training procedures which would be used during the modification phase of the project. The design of the modification phase of the project included precise specifications for shaping the behavior, identification of physical and verbal prompts to be used, the criteria for labelling a correct response, and objects or events and schedules to be used in reinforcing the correct response.

After the modification procedures were specified, they were discussed with the CDWs responsible for the resident to insure that the techniques discussed were understood. Occasionally, changes suggested by the CDWs were incorporated into the procedures at this point. After a specific procedure had been developed, a detailed description was written and placed in the nursing office to provide an accurate reference for the CDWs who were responsible for the project.

Project implementation. The CDW continued to measure and chart the resident's daily performance during the implementation phase. Periodic observations were made by the physical therapist and the behavior modifier in order to evaluate the effectiveness of the procedures and to verify

that the CDWs were conducting the project according to the design. When the procedures designed did not produce any change in the resident's behavior the physical therapist and the behavior modifier worked together to devise a new treatment procedure.

The physical therapist decided when a resident had sufficiently mastered a skill and a project could be considered complete and discontinued. The criterion typically specified was the independent performance of the target behavior. In some cases the resident had acquired a means of mobility such as independent ambulation, or ambulation with a rollator or a cane. Frequently the skill acquired was merely a precursor to independent mobility, such as standing or walking in parallel bars, and new projects had to be designed to teach the subsequent skills.

Project termination. A team composed of the project co-director, the staff physician, a registered nurse, the physical therapist, and the behavior modifier made the final decision concerning the amount of time a resident remained on the HIP unit. Treatment was successfully terminated if the child had advanced sufficiently in physical ability to be placed in another area of the hospital or in the community without danger of regression. If no significant physical or functional change had been noted for an extended period of time (6 months) and the prospects of further improvement were

limited, treatment was discontinued. Whenever treatment was discontinued the resident was transferred from the program unit and placed on another ward in the hospital. A program was developed on this ward to improve or maintain the resident's current functioning level.

Project evaluation. The effectiveness of the program was evaluated by comparing the baseline and the modification phase of each physical therapy-behavior modification project. The data presented for the baseline phase of each project consists of the resident's average performance for the entire baseline phase or the performance for the project. The data reported for the modification phase are the average performance by the resident in the last six to ten sessions prior to project completion. The number of sessions used to compute these averages fell below ten only when there was a sudden deceleration in a resident's rate of performance and then a resumption of performance at the previous rate. If an acceptable explanation was given for the poor performance (resident ill, data collected wrong, project conducted improperly) the data for these sessions were disregarded. The data presented for each resident represent at least six sessions.

Cost Procedure

There were a number of different costs associated with

the operation of a project of this type. These costs were divided into five categories which were selected for the following reasons. First, some costs were directly attributable to a project while others were general costs of program operation which had to be distributed among individual projects. For example, it was possible to directly assign the cost of the CDW technicians treatment time to the project, but staff training costs had to be distributed across projects. Second, some costs had to be identified separately for purposes of analysis. Finally, some costs, which could have been measured directly, were distributed across projects because they were minimal costs and would have been too time-consuming and expensive to determine directly. For example, the cost of reinforcers was distributed rather than directly assessed because it accounted for a very small proportion of the total cost and the time and expense to record the cost for each project each day seemed unworthy of the effort involved.

The five cost categories utilized were: Direct Cost 1, Direct Cost 2, Indirect Cost 1, Indirect Cost 2, and Total Treatment Cost. The costs included in each of these categories is described below. A summary of these cost categories is presented in Table 1.

Direct Cost 1 included those costs which occurred as a function of the amount of time that a CDW spent training a

TABLE 1

Summary of Cost Categories

Category	Cost	Calculation
Direct Cost 1	CDWs time spent training a subject in a physical therapy-behavior modification project.	CDWs average hourly wage times the number of hours required for a subject to complete a physical therapy-behavior modification project.
Direct Cost 2	Medical intervention required before a skill could be learned.	Total cost of surgery and/or bracing.
Indirect Cost 1	Reinforcers consumed by the subject in the course of a physical therapy-behavior modification project.	Average cost of reinforcers per project session times the number of sessions conducted to complete a physical therapy-behavior modification project.
Indirect Cost 2	Consultation by the physical therapist and the behavior modifier.	Behavior modification consultant's hourly wage times (60 hours a month on program unit divided by 60 projects) plus Physical therapist's hourly wage times (the average amount of time required to set up a project plus the average number of monthly observations of the project.

resident in a physical therapy-behavior modification project. The length of time spent training each resident was recorded daily by the CDW as a part of the project data collection procedure. The project secretary collected this data and recorded the training time on a form which was kept for each resident. The following information was entered on these forms: (1) the name of the resident, (2) a list of the skills being trained, (3) a daily record of the amount of time spent training each skill, (4) a monthly total of the time spent training each skill, (5) a running total of the time spent training each skill until that skill was mastered, and (6) average performance of the last five days of the month. A sample of a HIP resident training time record is shown in Appendix A.

Direct Cost 1 was computed by multiplying the average hourly wage earned by child development workers on the program unit by the number of hours required to teach a skill to criterion. The figure used for the hourly wage was attained by averaging the hourly salaries of all child development workers employed on the HIP unit. The criteria for the project completion were determined through an analysis of the project data (e.g., number of steps per session) and the agreement of the physical therapist (a qualitative evaluation of performance).

The second direct treatment cost category, Direct

Cost 2, included medical costs such as surgical intervention and/or bracing. These costs were obtained from the School of Medicine, University of Iowa, Iowa City, which provided all of the orthopedic treatment required.

Indirect treatment costs were those costs which occurred as a result of the physical therapy-behavior modification treatment program, but were not directly attributed to any one resident or project. Indirect treatment costs were also divided into two categories. The costs for Indirect Cost 1 were the costs of reinforcers. These costs were found by summing the monthly cost of reinforcers received from the dietary service at the hospital and the monthly expenditure for other reinforcers from a fund established especially for the purpose. This total was divided by the number of project sessions conducted monthly. This resulted in an average cost of reinforcers per session. The average cost of reinforcers per session was multiplied by the actual number of sessions conducted to complete each physical therapy-behavior modification project.

The costs in the Indirect Cost 2 category were the costs of consultation by the physical therapist and the behavior modifier. The behavior modifier spent sixty hours a month on the training unit. Since consultation costs were not specified for each resident, these costs were distributed among all residents who were in projects. The costs for the

physical therapist were estimated from time samples taken while she designed and observed projects.

When the direct and indirect treatment costs were identified it was possible to determine the total cost of teaching a resident a specific skill. This was achieved by adding the costs of each of the four categories previously identified.

The only costs under consideration in this study are those costs which were directly relevant to the treatment given in the physical therapy-behavior modification projects. There was one significant cost element, residual costs, not included in the study. Residual costs were all of those costs which were necessary to maintain the general care and services which the residents received from the institution. This category included nursing care, institutional maintenance and repair, food, clothing, laundry, etc. Residual costs were simply those costs remaining after the direct and indirect treatment costs have been subtracted from the total amount spent per resident during the project period. These costs were not included in the study since they were costs which would have been incurred with or without the treatment program.

It is important to recognize, therefore, that the cost analysis in this project is a cost-per-behavior-change analysis, and not a cost effectiveness analysis as such. A

cost effectiveness analysis would require a determination of the extent to which the project required additional costs rather than a reallocation of existing resources. This question is being answered in a separate study.

CHAPTER III

RESULTS

Table 2 presents the effectiveness data for one hundred and forty-one physical therapy-behavior modification projects conducted during the first sixteen months of the HIP program. The projects are listed in a developmental sequence with the more complex behaviors presented first. The projects are divided into three categories completed, partially completed, and no progress. This division identified the stage of a project at the time the data for this study were summarized.

The category of completed projects contains 58.2% of the projects conducted during the study. A discussion of the individual data from this category constitutes the major portion of this chapter.

The partially completed category includes those projects in which significant progress was being shown, but which were still in progress at the completion of the study. This category was distinguished from the completed category since the subjects had not completely mastered the skills, although in many instances the projects were close to completion. For example, the difference between the subjects in the two categories on ambulation with a rollator projects is simply that those in the complete category were able to avoid

TABLE 2

Physical Therapy - Behavior Modification Projects

	Stage		
	Completed	Partially completed	No progress
Independent ambulation	3	4	0
Independent ambulation between furniture	2	1	0
Ambulation with one or two canes	1	1	0
Ambulation with an assistive device - roller cane	0	2	0
Ambulation with an assistive device - rollator	4	9	0
Ambulation holding onto trapeze	0	4	0
Ambulation with a prompt	2	1	0
Side stepping at furniture	0	1	0
Ambulation up and down the stairs	1	0	0
Ambulation in parallel bars	11	4	0
Ambulation in step ladder with support	1	1	0
Acquiring standing position independently from a chair	3	0	0
Acquiring standing position at furniture	3	2	0
Maintaining independent standing	3	1	0
Maintaining standing position with one or two canes	3	0	0
Maintaining standing position with rollator or walker	5	0	0
Maintaining standing position in parallel bars	8	3	2
Sliding down wall into squat position	1	0	0
Maintaining crawl position	1	1	1
Kneeling independently	0	2	0
Knee walking with support	1	0	0
Acquiring kneeling position at furniture	3	0	0
Maintaining kneeling position at furniture	7	2	0
Acquiring sitting position - back against wall	1	0	0
Sitting position - raise head and shoulders	0	1	0
Maintaining sitting balance - tailor style	2	3	0
Maintaining sitting balance - straight leg	1	0	0
Maintaining sitting balance - overedge of table	0	1	0
Moving independent on scooter board	0	1	0
Rolling over	2	2	0
Prone over bolster, hold head up	1	0	0
Prone over bolster, push onto forearms	1	1	0
Prone, push onto forearms	1	0	0
Self-feeding with a spoon	11	5	2
Total	83	53	5

objects and follow a person while those in the partially complete category were not yet able to guide the rollator without occasional assistance from the staff.

The projects in the no progress category have shown limited or no success. There were five projects which failed. The reflex levels of the four residents involved in these five projects were between four and six months. Only one of these residents was able to maintain a sitting position and this was an unconventional position. Three of the four residents had completed one other project successfully. All four of the residents were moved from the unit when they failed to show continued progress.

The cost and effectiveness data for the 83 successfully completed physical therapy-behavior modification projects are presented in Tables 3 through 7. The projects are divided into five tables to facilitate discussion. Table 3 includes ambulation projects. Table 4 shows preambulation skills such as maintaining and acquiring standing and kneeling balance. Table 5 presents data on sitting balance. Table 6 includes miscellaneous physical therapy projects, and Table 7 shows projects on self-feeding with a spoon.

The first four columns to the right of the subject column in Table 3 through Table 7 are included to provide a pretreatment description of the subject. This information includes the age of each subject, his sex, his reflex level,

and his physical functioning level as they were assessed when the resident was admitted to the unit. The pretreatment descriptions of the subjects are provided so that a subject could be compared with other subjects who had acquired the same behavior. An analysis of the degree of behavior change and the costs involved in achieving this change could not be made without this descriptive information since the behavioral baseline measures do not reveal the amount of shaping required to generate initial performance.

The column on project baseline presents a measure of the performance of each subject on a specified behavior before training began. This baseline measure identifies the subject's initial performance, and can be compared with the performance of the subject at the end of the modification phase. For each subject baseline and modification phases are presented in identical units of measurement. These units of measurement are not always identical among subjects within the same behavioral category. An examination of the data for S1 and S3 within the category, ambulation in parallel bars, illustrates this difference. The data for S1 are presented in terms of the number of steps taken per minute while the data for S3 are presented as the number of feet walked per minute. Topographical features of the behavior to be changed sometimes dictated a change in the unit of measurement to more adequately reflect the desired change.

In most cases a comparison of these two phases for each subject will provide an indication of the significance of the change in the subjects performance. However, for S24 in the category "acquiring sitting position" this comparison alone is not adequate. Comparison of the baseline and modification phase for S27 indicates that this resident improved from 0% to 100% and that this improvement occurred after 78.9 hours of training. As the descriptive information on the left of the project baseline indicates, this fourteen year old male had the reflex level of a child of two to six months of age upon entry into the program. A copy of the reflex testing chart can be found in Appendix B. The information in the physical functioning column indicates that he was functioning developmentally at the 11 week level. Appendix C on Physical Functioning Level shows that this subject was initially unable to push onto his forearms from the prone position. This information should be considered when an interpretation of the significance of the behavior change is made.

All of the behaviors taught had some functional value for the resident, usually in the form of assisting him to acquire new independence with skills such as self-feeding with a spoon, maintaining sitting balance or pulling to standing, etc. Frequently the behaviors identified for change were selected to increase the independent mobility of

the resident. Since more than three-fourths of the residents on the program unit were unable to maintain independently the standing position and many had never stood even with assistance for any period of time, it was necessary to teach behaviors which grew progressively more difficult so that physical endurance could be increased. This accounts for the large number of residents in categories such as: "maintaining standing position in the parallel bars" and "ambulation in the parallel bars."

The direct treatment costs were those costs determined by the number of hours spent by the CDWs training the resident to perform the behavior to criterion. This cost was computed by multiplying $2.41, the average hourly wage earned by a CDW on the program unit, by the number of hours required for the resident to complete the training. All training on the unit was conducted by the CDWs who were under the supervision of the physical therapist and behavior modification consultant. These costs are listed in the Direct Cost 1 column in Tables 3 through 7. In most cases this cost represents the largest dollar expenditure required to achieve the behavior change. Because this cost is directly related to the number of hours necessary to achieve the change in performance, those behaviors which required the greatest number of hours to complete also have the largest total cost associated with them.

Cost for braces and surgical intervention are listed in the Direct Cost 2 column. Only eleven residents required such treatment. Several of the eleven residents who received medical treatment acquired more than one skill which was directly related to the medical intervention. Although such costs were nonreccuring costs and could be distributed across the costs for all skills acquired, they were added to the first skill the subject acquired after the intervention. For other skills acquired by that subject, the cost for the medical intervention was bracketed and placed in the Direct Cost 2 column, but it was not added into the total treatment cost for the acquisition of that skill.

The Indirect Cost 1 column was the category with the lowest costs. This was truefor all residents irrespective of the targeted behavior. The costs shown in the Indirect Cost 1 column was computed by multiplying the actual number of sessions conducted by $.0468, the average daily cost of reinforcement per project session on the program unit.

This cost was minimal for all subjects and was absent or neglible for S23, S11, and S7 in spite of the fact that these projects were conducted for an extensive period of time. The cost of reinforcers for these residents was reduced because their meals were used to reinforce their performance on the project. The cost for the meal was not computed since it did not introduce a new cost into the system.

The same rationale was used for not including the cost of the meals in the Indirect Cost 1 column for the residents who learned independent feeding with a spoon.

Indirect Cost 2 represents the category where the second greatest cost for the majority of the projects was incurred. This cost represented the cost of the consultations by the physical therapist and the behavior modifier.

Table 3 presents the data for eight projects related to ambulation. The five subjects in the first two ambulation categories represent the most obvious examples of success in the program. An examination of the physical functioning level for these five subjects shows that none of them were ambulatory prior to entering the program, however, by the end of this study all five subjects were taking several hundred independent steps during their projects. The subjects in the independent ambulation category were required to do their projects under a variety of circumstances such as, walking outside on cement and gravel surfaces, walking on the ramps and in the hospital corridors, etc. If the resident was unable to perform in any of these situations a project was designed to teach the behavior. The "ambulation up and down stairs" project designed for S15 provides an example of a project to correct such a deficit.

The completion criteria for the "ambulation with an

assistive" device projects were similar to those for independent ambulation. In both cases an effort was made to insure that the subject's performance would be maintained once the subject was moved from the program unit.

The four remaining projects, ambulation in step ladder with support, ambulation parallel bars, ambulation with a prompt and ambulation with one or two canes are all categorized as gait training projects. These projects were primarily concerned with teaching the subject to take steps and later requiring him to improve the quality of his step. The specification for completion in these projects was based almost entirely on the quality of the response. This accounts for vast difference in the rate of steps taken per minute among subjects who have completed projects in this category. Subjects who successfully completed projects in gait training were then taught progressively more complex ambulation skills. S5 provides an ideal example of such a sequence of behaviors since this individual's progress can be traced from the parallel bars to ambulation with canes and finally independent ambulation.

Table 4 lists preambulation skills. These are behaviors which a subject must learn prior to learning to walk. Acquisition of these behaviors helps the individual develop sufficient trunk and hip control to maintain standing balance for an extended period of time. Since many of the subjects

in this category had never borne their full body weight for any period of time, it was necessary to spend many hours teaching a subject to bear weight. Because some of the residents had quite poor balance it was necessary to have a second CDW assist with the project. When this was necessary a letter is placed next to the figure in the hours column to indicate that the hours required to achieve this behavior are the hours of two trainers rather than one.

The four subjects in Table 5 were in projects to improve their trunk control by learning to maintain and acquire sitting positions. A criterion for sitting straight was specified for each subject and the data in this table are based on the subject's ability to meet this criterion. All of these subjects were able to sit up straight and maintain their balance independently before the project was considered complete.

Subject 34 learned to acquire the sitting position from the floor. The behavior was taught in five separate steps (1) pushing onto forearms from a prone position, (2) maintaining balance and rolling onto his right side, (3) pushing up onto his arms, moving them closer to his body and raising his trunk, (4) placing his back against the wall with his arms at his sides, and (5) maintaining this position for thirty seconds. Initially, the resident was unable to perform step (1), therefore, it was necessary to teach him this

behavior first.

Table 6 includes those skills which were taught to residents who were severely handicapped. None of the residents in these four projects had sufficient trunk control to maintain a sitting position. These skills were selected with the objective of teaching the subjects better head control so that self-feeding skills and sitting balance could be developed later.

Table 7 presents the data for the self-feeding projects conducted on the HIP unit. S10 is included in this data because she did not feed herself independently prior to her admission to the unit. However, after 6.3 hours of training she was capable of feeding herself independently.

The remaining ten residents were initially totally unable to feed themselves independently. Five of these residents were on restricted diets and were permitted only pureed food. The number of independent bites listed in the baseline and modification phases of the project represent the average number of bites taken in each of the three daily meals. The baseline is presented as zero because although the subject ate each meal it was necessary to assist him to take each bite. The projects were considered complete after it was no longer necessary for the CDW to work individually with a subject and physically assist him to eat his meals. The large difference in the number of independent bites taken

by the different subjects is due to the size, age and the motivation of the individual. Many of the subjects were encouraged to eat more and were given a second serving of food after they had finished the first serving.

The number of hours required to teach these ten residents to feed themselves was quite high. One reason for this was that the projects were conducted three times daily. Another reason was that the CDWs were required to work between fifteen minutes and one-half-hour with each resident in a project. This stipulation was made to assure that the CDWs would carry out the specified procedures with caution, rather than hurrying the resident through the meal.

TABLE 3
Ambulation Projects

Subject	Age	Sex	Reflex level	Physical level	Project baseline	Project modification	Hours	Direct cost 1	Direct cost 2	Indirect cost 1	Indirect cost 2	Total treatment
Independent ambulation												
S 5	11	M	12-18 Mo.	15	38.8 steps/min.	103.6 steps/min.	51.9	$ 125.08	$(800.00)	$ 14.60	$ 38.01	$ 177.69
S15	17	F	8-18	20	0 steps/min.	149.3 steps/min.	193.3	465.85		10.20	88.36	564.41
S43	15	F	15-18	17	0 steps/min.	75.3 steps/min.	105.7	245.10		30.14	75.94	351.18
Independent ambulation between furniture												
S 3	15	F	18 Mo.	17	0 steps/min.	53.8 steps/min.	65.5	158.10		17.13	44.22	219.45
S 7	16	F	a	18	0 steps/min.	67.3 steps/min.	244.8	589.97		1.08	95.94	686.99
Ambulation with one or two canes												
S 5	11	M	12-18 Mo.	15	6.99 steps/min.	27.6 steps/min.	16.3	39.28	(800.00)	6.32	18.01	63.61
Ambulation with an assistive device-rollator												
S 4	17	M	6 Mo.	12	13.5 Steps/min.	52.73 steps/min.	19.0	45.79		5.80	16.63	68.22
S21	12	M	6	17	4.7 steps/min.	53.2 steps/min.	114.3	275.46		26.96	68.36	370.78
S25	8	M	12	14b	3.0 steps/min.	32.4 steps/min.	44.5	107.25	(517.50)	13.62	35.94	156.81
S46	10	M	6-18	18	0 steps/min.	102.3 steps/min.	35.5	85.56		9.87	26.29	121.72
Ambulation with a prompt												
S18	7	F	6-18 Mo.	19	0 steps/min.	20.2 steps/min.	13.7	33.02	111.00	2.01	7.14	153.64
S43	15	F	15-18	17	0 steps/min.	75.3 steps/min.	27.6	66.52		8.52	22.84	97.88
Ambulation up and down stairs												
S15	17	F	8-18 Mo.	20	0% trials passed	100% trials passed	10.4	25.06		10.20	26.97	62.23

Table 3 - continued

Subject	Age	Sex	Reflex level	Physical level	Project baseline		Project modification		Hours	Direct cost 1	Direct cost 2	Indirect cost 1	Indirect cost 2	Total treatment
Ambulation in parallel bars														
S 1	20	M	6-18 Mo.	12	.6	steps/min.	3.5	steps/min.	.6	$ 1.45	$	$ .47	$ 3.34	$ 5.26
S 3	15	F	18	17	7.2	feet/min.	18.0	feet/min.	2.8	6.75		1.26	5.27	13.28
S 4	17	M	6	12	3.0	feet/min.	14.2	feet/min.	9.8	23.62		2.77	8.03	34.42
S 5	11	M	12-18	15	3.9	steps/min.	12.6	steps/min.	7.7	18.56	800.00	2.39	8.92	829.87
S 6	16	M	6-12	12	2.6	feet/min.	10.2	feet/min.	18.8	45.31		5.99	16.64	67.94
S14	19	F	6-18	10	1.8	steps/min.	6.8	steps/min.	43.2	104.11	208.50	9.50	25.60	347.71
S25	8	M	12	14b	5.9	steps/min.	12.3	steps/min.	2.9	6.87	517.50	.75	4.03	529.33
S31	20	M	8-18	10	1.6	steps/min.	14.8	steps/min.	22.0	53.02	229.50	6.51	18.00	307.03
S37	20	F	6-18	18	.0	feet/min.	20.9	feet/min.	11.9	28.68		.66	3.75	33.09
S42	18	F	12	18	.7	steps/min.	8.4	steps/min.	35.6	85.80c	(2230.20)	2.15	12.49	100.44
S44	18	M	6	11	2.6	steps/min.	29.0	steps/min.	47.6	114.72c		7.53	20.76	143.01
Ambulation in step ladder with support														
S37	20	F	6-18 Mo.	18	2.4	steps/min.	21.5	steps/min.	33.7	81.22		3.98	11.80	97.00

a untestable because of large size and low motivation grossly normal to 6 mo. level equilebrium maybe 12-15 mo.

b extreme spasticity in lower extremities

c hours marked with letter in common indicate two trainers were needed to conduct project

TABLE 4
Preambulation Projects

Subject	Age	Sex	Reflex level	Physical level	Project baseline	Project modification	Hours	Direct cost 1	Direct cost 2	Indirect cost 1	Indirect cost 2	Total treatment
Acquiring standing position independently from chair												
S15	17	F	8-18 Mo.	20	36% trials passed	98% trials passed	22.5	$ 54.30	$	$ .00	$ 4.93	$ 59.23
S16	22	F	18	21	0% trials passed	70% trials passed	24.2	58.32		9.41	25.60	93.33
S27	17	F	normal	normal	13% trials passed	97% trials passed	2.1	5.06		.66	3.75	9.47
Acquiring standing position at furniture												
S29	14	M	2- 6 Mo.	12	0% trials passed	100% trials passed	29.9	72.06		7.44	20.76	100.26
S37	20	F	6-18	18	0% trials passed	95% trials passed	1.7	4.10		.19	2.66	6.95
S44	18	M	6	11	0% trials passed	100% trials passed	5.4	13.01		2.62	8.58	24.21
Maintaining independent standing												
S 1	20	M	6-18 Mo.	12	1.2' out of 5'	4.9' out of 5'	37.4a	90.14		3.28	10.70	104.12
S18	7	F	6-18	19	.2' out of 15'	15.0' out of 15'	12.6a	30.36	(111.00)	1.17	5.06	36.59
S22	16	M	15-18	18	.0' out of 10'	10.0' out of 10'	67.6a	162.92		7.30	20.08	190.30
Maintaining standing position with one or two canes												
S26	8	M	15-18 Mo.	18	1.5' out of 10'	9.1' out of 10'	25.6a	61.70		4.07	12.49	78.26
S37	20	F	6-18	18	3.7' out of 10'	10.0' out of 10'	.2	.48		.09	2.38	2.95
S42	18	F	12	18	1.2' out of 5'	5.0' out of 5'	9.4a	22.66	(2230.20)	2.62	8.58	33.86
Maintaining standing position with rollator or walker												
S 3	15	F	18 Mo.	17	1.0' out of 5'	4.2' out of 5'	4.2	10.12		2.48	8.23	20.83
S 4	17	M	6	12	4.8' out of 10'	10.0' out of 10'	44.6a	107.48		6.08	17.33	130.89
S 6	16	M	6-12	12	4.9' out of 10'	9.9' out of 10'	20.0a	48.20		3.98	11.80	63.98
S25	8	M	12	14b	4.0' out of 10'	9.0' out of 10'	25.4	61.21	(517.50)	10.67	28.36	102.72
S28	14	F	4-12	10	2.9' out of 15'	15.0' out of 15'	15.8	38.08		.00	18.01	56.09

Table 4 - continued

Subject	Age	Sex	Reflex level	Physical level	Project baseline	Project modification	Hours	Direct cost 1	Direct cost 2	Indirect cost 1	Indirect cost 2	Total treatment
					Maintaining standing position in parallel bars							
S 9	22	M	12-15 Mo.	10	4.8' out of 10'	9.9' out of 10'	90.8a	$ 218,82	$	$ 13.38	$ 35.26	$ 267.46
S14	19	F	6-18	10	2.6' out of 10'	10.0' out of 10'	10.3	24.82		3.74	11.12	39.68
S17	11	F	6	8	4.0' out of 10'	8.1' out of 15'	14.1	33.98	517.50	6.60	18.70	576.78
S19	12	F	6	10	8.5' out of 15'	15.0' out of 10'	3.8	9.16	517.30	.42	3.21	530.39
S31	20	M	8-18	10	5.0' out of 10'	10.0' out of 10'	2.2	5.30		1.36	5.48	12.14
S33	12	F	2-12	8	2.6' out of 10'	9.8' out of 10'	7.0	16.87	1334.45	5.24	15.25	1371.81
S42	18	F	12	18	1.5' out of 5'	4.7' out of 5'	1.5	3.62	(2230.20)	1.17	5.06	9.85
S44	18	M	6	11	1.5' out of 20'	17.0' out of 20'	10.2	24.58		2.39	8.03	35.00
					Sliding down a wall into squat position							
S42	18	F	12	18	50% trials passed	100% trials passed	11.6a	27.96	2230.20	4.21	12.49	2274.86
					Maintaining crawl position							
S23	16	M	2- 6	3	.0' out of 10'	9.7' out of 10'	44.2	106.52		13.43	35.26	155.21
					Knee walking with support							
S21	20	M	8-18	10	.6 steps/min.	14.3 steps/min.	20.3	48.92		7.72	21.46	78.10
					Acquiring kneeling position at furniture							
S 6	16	M	6-12	12	0% trials passed	94% trials passed	6.2	14.94		1.73	13.56	30.23
S17	11	F	6	8	30% trials passed	90% trials passed	15.3	36.87		7.07	19.39	63.33
S37	20	F	6-18	18	0% trials passed	100% trials passed	1.1	2.65		.51	3.42	6.58
					Maintaining kneeling position at furniture							
S 8	22	F	4- 6	5	2.5' out of 10'	9.2' out of 10'	43.5	104.84		12.22	32.49	149.55
S24	16	F	6	3	3.9' out of 10'	10.0' out of 10'	14.5	34.95		4.07	12.49	51.51
S25	8	M	12	14b	4.4' out of 10'	9.1' out of 10'	2.4	5.78		.80	4.10	10.68
S31	20	M	8-18	10	.5' out of 10'	10.0' out of 10'	5.4	13.01		2.90	9.06	24.97
S32	18	M	2-12	3,7	5.3' out of 10'	10.0' out of 10'	28.7	69.17		8.05	22.15	99.37
S35	13	F	4-16	3,8	2.7' out of 10'	8.9' out of 10'	15.9	38.32		7.53	20.76	66.61
S44	18	M	6	11	6.4' out of 10'	9.5' out of 10'	4.9	11.83		2.57	8.51	22.91

a Hours marked with letter in common indicate two trainers were needed to conduct project

b extreme spasticity in lower extremities

TABLE 5
Sitting Projects

Subject	Age	Sex	Reflex level	Physical level	Project baseline	Project modification	Hours	Direct cost 1	Direct cost 2	Indirect cost 1	Indirect cost 2	Total treatment
Acquiring sitting position - back against the wall												
S34	14	M	2- 6 Mo.	3,5	0% trials passed	100% trials passed	78.9	$ 190.15	$	$ 16.71	$ 43.53	$ 250.39
Maintaining sitting position - tailor style												
S17	11	F	6	8	3.0' out of 10'	9.9' out of 10'	9.4	22.68		3.70	11.12	37.50
S25	8	M	12	14a	3.6' out of 10'	8.1' out of 10'	18.3	44.10		4.59	13.18	61.87
Maintaining sitting position - straight leg												
S13	14	F	6	6	2.9' out of 15'	14.6' out of 15'	12.1	29.21		2.06	7.20	38.47

a extreme spasticity in lower extremities

TABLE 6
Miscellaneous - Physical Therapy Projects

Subject	Age	Sex	Reflex level	Physical level	Project baseline	Project modification	Hours	Direct cost 1	Direct cost 2	Indirect cost 1	Indirect cost 2	Total treatment
					Rolling over							
S 2	15	F	4- 6 Mo.	3a	40% trials passed	95% trials passed	17.1	$ 41.21	$	$ 6.13	$ 17.33	$ 64.67
S40	17	M	2- 6	2,5	0% trials passed	97% trials passed	13.0	31.33		3.74	11.12	46.19
					Prone, over bolster, hold head up							
S39	3	M	6	b	27% trials passed	100% trials passed	12.2	29.40		4.57	13.18	47.15
					Prone, over bolster, push onto forearms							
S36	15	M	5- 6	1	2.7' out of 10'	9.2' out of 10'	18.8	45.31		11.00	29.04	85.35
					Prone push onto forearms							
S24	16	F	6	3	.0' out of 15'	14.7' out of 15'	18.7	45.07		10.81	29.04	84.92

a spastic quadriplegic

b untestable due to extreme flexor spasticity

TABLE 7
Self-feeding Projects

Subject	Age	Sex	Reflex level	Physical level	Project baseline	Project modification	Hours	Direct cost 1	Direct cost 2	Indirect cost 1	Indirect cost 2	Total treatment
S 1	20	M	6-18 Mo.	27	0 independent bites	85 independent bites	95.6	$230.42	$	$	$ 33.02	$ 263.44
S10	14	F	6	27	67	106	6.3	15.18			12.39	27.57
S16	22	F	18	26	0	38	59.0	142.19			41.88	184.07
S17	11	F	C	27	0	93	240.2	578.79			111.54	690.33
S19	7	F	6-18	27	0	35	27.1	65.38			17.71	83.09
S20	12	F	6	27	0	84	24.0	57.84			11.13	68.97
S22	16	M	15-18	27	0	94	213.2	513.69			109.77	623.46
S39	14	M	2- 6	26	0	75	102.6	247.22			76.13	323.35
S33	13	M	2- 6	27	0	38	92.2	222.20			33.04	255.24
S43	15	F	15-18	26	0	57	65.0	156.65			58.70	215.35
S44	18	M	6	27	0	63	145.0	349.45			35.40	384.85

CHAPTER IV

DISCUSSION

In this study it was possible to relate cost to behavior change in a physical therapy-behavior modification program with severely and profoundly retarded multiply handicapped residents.

One of the most important features of the program was the successful attempt to incorporate treatment procedures into the daily routine of the ward personnel. In essence, the child development workers, who had formerly provided only custodial care for these physically handicapped residents, took the place of physical therapy aides. They worked under the supervision of the physical therapist to develop new skills in the residents under their care. This arrangement presented an opportunity for physically handicapped residents to receive intensive physical therapy twice daily. With the child development workers serving in the capacity of both careworkers and physical therapy aides it was possible to integrate program activities into the daily routine.

Previously all physical therapy treatment at the hospital had been conducted in the physical therapy department by the physical therapist and two or three physical therapy aides under her supervision. Each of these individuals was able to treat about 10 residents for approximately

one-half hour a day. On the program unit the physical therapist supervised nineteen day-time CDWs as they conducted the physical therapy-behavior modification projects. The economic advantage of the latter arrangement is evident if one simply compares the hourly wages of three individuals who could potentially carry out the physical therapy treatment. Each hour of treatment by a CDW cost $2.41. An hour of treatment conducted by the physical therapist cost $6.52. The completed projects reported in this study on Tables 3 through 7 resulted in 3,146.3 hours of treatment and cost $7,582.58 on the program unit. This same number of treatment hours would have cost $13,214.42 if they had been carried out solely in the physical therapy department by the physical therapist and two physical therapy aides.

The hourly salary for the physical therapist contributes the greatest cost to this method of treatment. When the physical therapist directly treats a resident the cost for this treatment is more than twice the cost of direct treatment by either the physical therapy aide or the CDW. Since the expertise of the physical therapist is a critical element in programming for a multiply handicapped population it would appear to be more efficient to use these skills to design projects for the subjects and to supervise the techniques used by CDWs. The study presented here utilized the physical therapist's skills in just that manner.

Although it is apparent that her time was used more efficiently this way, it was not possible to make more precise statements about these costs since direct measures of her time in various activities were not kept.

The totals in the Indirect Cost 2 category represent the combined costs for the consultations by the physical therapist and the behavior modifier. The cost for the behavior modification consultant's time on the unit each month were distributed among the projects conducted that month. This distribution undoubtedly overestimated the amount of time spent consulting directly on projects since the consultant was frequently involved with decisions concerning the total program and not just the separate projects.

The separation and the direct measurement of the costs for these two individuals would be interesting for several reasons. First, the direct measurement of the cost for supervising and designing the individual physical therapy-behavior modification projects would result in a direct cost figure which would more accurately represent the cost of the resident's behavior change. Second, by the end of the first year it was evident that the amount of time needed to supervised the behavior modification techniques used by the CDWs was greatly reduced. The CDWs became more precise in their data collection, their delivery of reinforcers, their use of prompting and shaping techniques, and other relevant

behaviors. This improvement in the skills of the trainers resulted in a significant decrease in the amount of time required for the supervision of the physical therapy-behavior modification projects by the behavior modifier. In addition, the costs for the consultations with the behavior modifier were greatly reduced as the physical therapist became more skilled in designing and supervising the physical therapy-behavior modification projects.

If these costs were enumerated it should be possible to determine the direct costs of designing and supervising each physical therapy-behavior modification project, and the kind of training and the number of hours of supervision necessary to develop effective trainers. It should also be possible to estimate the optimal number of hours of direct consultation required with the behavior modifier to develop this expertise in the trainers.

An alternative method of analyzing similar behavior modification projects would be to present the costs of the individual projects designed for a resident rather than the costs per behavior change. If this were done one might find that the cost for the design of the initial projects would be quite high but that the cost of later projects for the same individual would gradually diminish. Expensive start-up costs would be expected in individual behavior modification projects since the design of these projects is specific

to the individual and the problem. One expense contributing to the behavior modification start-up costs would be extra time spent by the professional staff designing and redesigning the project until an effective method for behavior change was developed. These costs would be reduced once a proper shaping technique and an effective reinforcer had been identified.

It is not possible to evaluate the overall effectiveness of the program at this time since such an evaluation could only be made after consideration of the long-range benefits gained by the individuals involved. Opportunities for educational and vocational training experiences made available to the resident as a result of new skills acquired in this program represent some long-range benefits the resident might derive. The ultimate benefit to these individuals and those responsible for the overall funding and operation of the program would be the discharge of the resident from the hospital and his placement or integration into the community.

The present study is not intended to perform an actual analysis of the benefits gained by either the subjects in the study or by the state and federal agencies who are the potential purchasers of such a program. An analysis of the cost effectiveness of this program would require a follow-up study to analyze the expense of the program in

terms of its immediate and long-range successes. The data from this study only permit a simple statement about the immediate success of the program in changing those behaviors which were deemed worthy of change and which should lead to long term benefits. The present study summarizes the completed projects and provides information about (1) the cost of each project, (2) specific measures of changes in the resident's behavior, and (3) the number of hours required to achieve this change.

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APPENDIX A

PAGE

HIP Residental Training Time Record 44

NAME _____

H.I.P. RESIDENTIAL TRAINING TIME RECORD

PAGE ____

MONTH _____

SKILL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	SHEET TOTAL	RUNNING TOTAL
SUB-TOTAL																																	

FORMAL PROJECTS IN:

	PROJECT	BASE LINE	PREVIOUS TERMINAL PERFORMANCE	AVERAGE TERMINAL PERFORMANCE
1.				
2.				
3.				
4.				

FOR: ☐ MONTH ☐ PROJECT

APPENDIX B

PAGE

Reflex Testing Chart 45

WOODWARD STATE HOSPITAL-SCHOOL

REFLEX TESTING CHART

Name _____ Reflex Level _____

Birthdate _____ Therapist _____

Date _____

LEVEL	NORMAL	REFLEXES	+	-	COMMENTS
SPINAL primitive reflexes	NEGATIVE AFTER 2 MO.	Flex. Withdrawal			
		Ext. Thrust			
		Crossed Extension			
BRAIN STEM primitive reflexes	NEGATIVE AFTER 4 MO.	Tonic Labyrinthine - SUPINE			
		Tonic Labyrinthine - PRONE			
		Pos. Supporting Reaction			
		Neg. Supporting Reaction			
	NEGATIVE AFTER 6 MO.	Asymmetrical TNR			
		Symmetrical TNR 1 Head in Flexion			
		Symmetrical TNR 2 Head in Extension			
MIDBRAIN quadripedal righting reactions	POSITIVE AFTER 2 MO.	Prone Labyrinthine - Righting on Head			
	POSITIVE AFTER 6 MONTHS	Sup. Labyrinthine Righting on Head			
		Body Righting Acting on Body			
		Amphibian			
		Protective Ext. Thrust			
	NEGATIVE AFTER 6 MO.	Neck Righting			
		Moro			
	POSITIVE FROM 6 MO. TO 2 YEARS	Landau			

LEVEL	NORMAL	REFLEXES	+	-	COMMENTS
CORTICAL bipedal - equilibrium reactions	POSITIVE AFTER 6 MO.	Supine - Roll side to side on tilt board			
		Prone - Roll side to side on tilt board			
	POSITIVE AFTER 8 MO.	Four foot kneeling			
	POSITIVE AFTER 12 MO.	Sitting			
	POSITIVE AFTER 15 MO.	Kneel - Standing			
	POSITIVE AFTER 18 MO.	Hopping 1 - Move to left or right side			
		Hopping 2 - Move forward			
		Hopping 3 - Move backward			
		Dorsiflexion			
	POSITIVE AFTER 15 MO.	See - Saw			
	POSITIVE AFTER 18 MO.	Simian Position			

APPENDIX C

PAGE

Physical Functioning Level 47

APPENDIX B

Physical Functioning Level

		Developmental Age
1.	Prone: lifts head momentarily (1-3 sec.)	4 weeks
2.	Prone: head in mid-position; lifts recurrently	8 weeks
3.	Prone: head in mid-position sustained 5 min or more	11 weeks
4.	Prone: on forearms	12 weeks
5.	Prone: rolls to supine	20 weeks
6.	Supine: rolls to prone	24 weeks
7.	Supine: lifts head	28 weeks
8.	Sits: briefly leans forward on hands sits erect for 1-2 min	28 weeks
9.	Sits: 1 minute erect, unsteady	32 weeks
10.	Stands: maintains for 1-2 min, hands held	32 weeks
11.	Sits: 10 minutes or more, steady	36 weeks
12.	Stands: holds rail, maintains full height for 5 min or more	36 weeks
13.	Prone: raises to crawl position	36 weeks
14.	Stands: pulls to feet at rail	40 weeks
15.	Prone: crawls	40 weeks
16.	Stands: acquires the position independently	46 weeks
17.	Standing: cruises at rail	48 weeks
18.	Walks: with both hands held	48 weeks
19.	Walks: with one hand held	52 weeks

		Developmental Age
20.	Stands: alone momentarily (1-3 sec.)	56 weeks
21.	Walks: few steps, starts, stops	15-16 months
22.	Walks: seldom falls	17-18 months
23.	Walks: fast, runs stiffly	17-18 months
24.	Stairs: walks up holding onto railing	21 months
25.	Stairs: walks down holding onto railing	24 months
26.	Grasp: requires moderate assistance	
27.	Grasp: performs without assistance	